PB-240 394

SHELLFISH STUDY OF SAN FRANCISCO BAY

Environmental Protection Agency
San Francisco, California

June 1974

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SHELLFISH STUDY
OF
SAN FRANCISCO BAY
APRIL - JUNE 1972

TECHNICAL REPORT

U.S. Environmental Protection Agency, Region IX
Surveillance and Analysis Division
San Francisco, California 94111

June 1974

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INFORMATION SERVICE
U S Department of Commerce
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BIBLIOGRAPHIC DATA SHEET	1. Report No. EPA - 909/9-74-003	2.

PB 240 394

4. Title and Subtitle

SHELLFISH STUDY OF SAN FRANCISCO BAY APRIL - JUNE 1972

5. Report Date: June, 1974

6.

7. Author(s)

~~U.S. EPA, Region IX, Surveillance and Analysis Division~~

8. Performing Organization Rept. No. 909/9-74-003

9. Performing Organization Name and Address

U.S. Environmental Protection Agency
100 California
San Francisco CA

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. Sponsoring Organization Name and Address

Same as block 9

13. Type of Report & Period Covered

14.

15. Supplementary Notes

16. Abstracts

Selected San Francisco Bay shellfish beds and their overlying waters were studied from April to June 1972. At a number of locations, bay shellfish were found to be contaminated by heavy metals and disease-causing bacteria, rendering them unfit for human consumption. When 1967 and 1972 surveys were compared, a decline was noted in both the shellfish mass and number of legal-sized clams.

17. Key Words and Document Analysis. 17a. Descriptors

*Shellfish, bacteria, heavy metals, sampling

17b. Identifiers/Open-Ended Terms

*San Francisco Bay

17c. COSATI Field/Group

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Springfield VA 22151

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18. Availability Statement

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19. Security Class (This Report) UNCLASSIFIED

21. No. of Pages 57

20. Security Class (This Page) UNCLASSIFIED

22. Price $4.25-2.25

FORM NTIS-35 (REV. 10-73) ENDORSED BY ANSI AND UNESCO. THIS FORM MAY BE REPRODUCED USCOMM-DC 8265-P74

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PREFACE

This study was conducted by the U.S. Environmental Protection Agency, under authority granted in the Federal Water Pollution Control Act, as Amended (33 U.S.C. 466 et seq.), 1970. Section 5 of the Act states that the Agency can collect and report data relating to ". . .causes, control, and prevention of water pollution. . .."

The final report was prepared and written by Kathleen G. Shimmin, Microbiologist, and Milton G. Tunzi, Biologist, EPA, Region IX, Surveillance and Analysis Division, Laboratory Services Branch. Cooperation and assistance were received from the following organizations during the conduct of the study:

State of California, Department of Fish and Game
State of California, Department of Health
State of California, San Francisco Bay Regional Water Quality Control Board
State of California, Water Resources Control Board
Johnson Oyster Company

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I. INTRODUCTION

From April to June 1972, a study was undertaken by the Environmental Protection Agency, Region IX, to determine whether or not selected San Francisco Bay shellfish beds were contaminated and to determine whether or not significant changes had occurred in the density and size of shellfish populations from 1967 to 1972. The beds surveyed were those with commercial potential (as assessed by Wooster, 1968) and with dimensions greater than 10,000 square feet.

Laboratory analyses were conducted to determine the existing health hazards as well as aesthetic quality of the shellfish beds. Determinations were made to test the presence of selected heavy metals (lead, mercury, cadmium, copper, chromium, zinc); pesticides, polychlorinated biphenyls (PCBs); and bacteria of sanitary significance (total and fecal coliforms, Salmonella). Results from San Francisco Bay sampling stations were compared with data obtained from analyses of commercial oysters grown at Drake's Estero.

II. SUMMARY AND CONCLUSIONS

Summary

Selected San Francisco Bay shellfish beds and their overlying waters were studied from April to June 1972. At a number of locations, Bay shellfish were found to be contaminated by heavy metals and disease-causing bacteria, rendering them unfit for human consumption. When 1967 and 1972 surveys were compared, a decline was noted in both the shellfish mass and number of legal-sized clams.

Conclusions

1. Shellfish from San Francisco Bay had bacterial levels which exceeded the standards set by the National Shellfish Sanitation Program. From April to May 1972, there were 31 violations documented out of 48 total samples. Fourteen out of a total of 16 beds were in violation at least once.

2. Salmonella organisms (disease-causing bacteria) were isolated from two beds sampled: S. kentucky was found at Burlingame (Station 9), and S. typhimurium at San Leandro Bay (Station 20).

3. Waters overlying the shellfish beds also were in violation of bacterial standards set by the National Shellfish Sanitation Program. During the period of study, the waters overlying nine out of 16 beds exceeded the prescribed limits.

4. Chemical assessment of samples of shellfish meat showed two stations to be in excess of Food and Drug Administration (FDA) guidelines for lead in food. Two stations also exceeded FDA guidelines for cadmium in food. Chlorinated hydrocarbons, including polychlorinated biphenyls, were below the most restrictive FDA tolerance limits set for certain foods and agricultural products.

5. Between 1967 and 1972, there has been a decline of approximately 50 per cent in both the shellfish mass and number of legal-sized clams found in 95 per cent of the shellfish beds.

III. BACTERIOLOGICAL ASSESSMENT

Introduction

Samples were collected from 16 shellfish beds and overlying waters in San Francisco Bay during the period of study and analyses were performed to determine the levels of total coliform (TC), fecal coliform (FC), and Salmonella. The results obtained were compared with those from the control bed, a commercial source (Johnson's Oyster Company) which grows oysters in Drake's Estero.

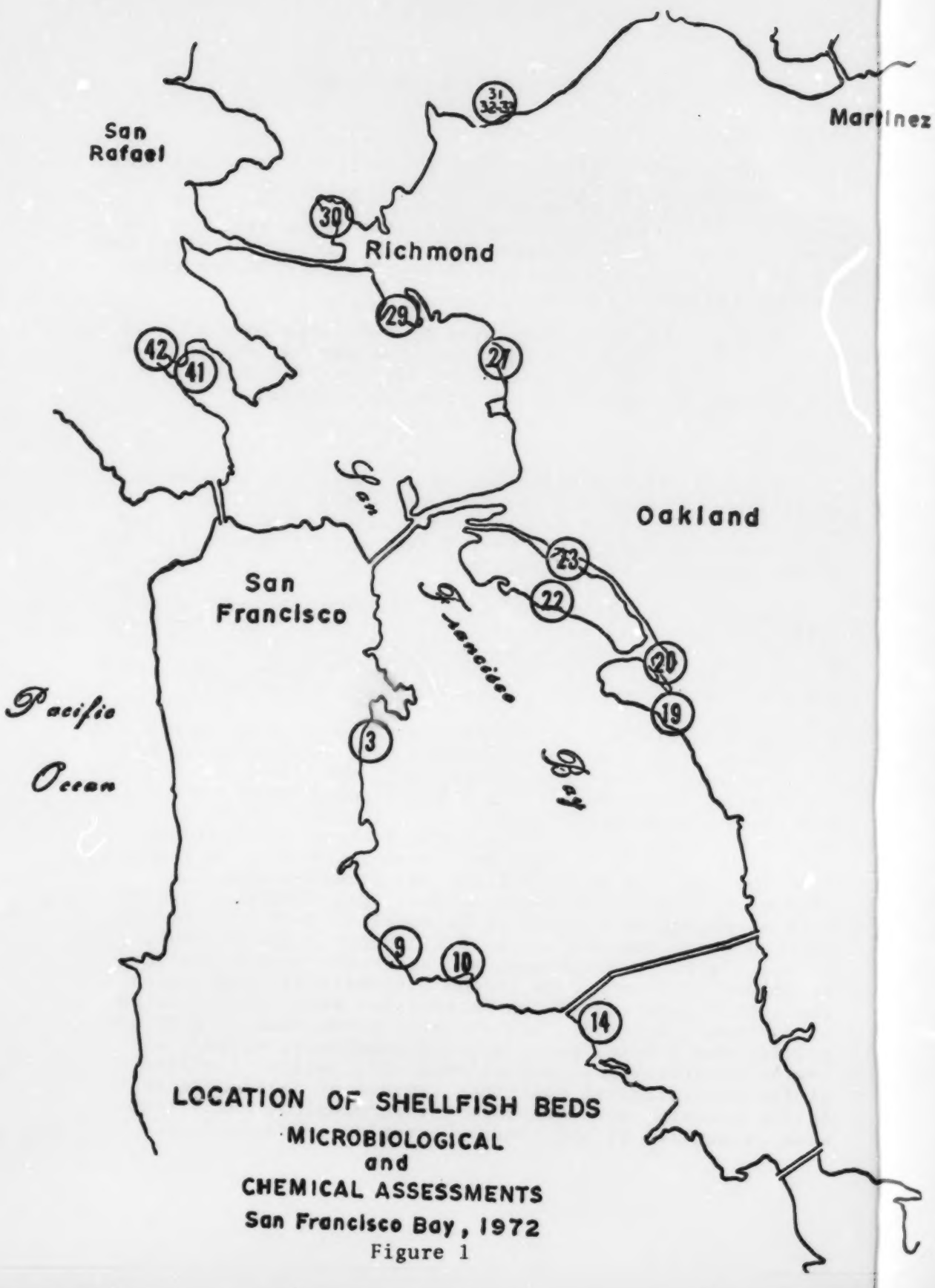
Figure 1 shows the location by numerical code of each shellfish bed sampled in San Francisco Bay. An explanation of the code appears in Table 1, while specific details on the location of each site are given in Appendix A.

Methods

Water samples were collected at three points over each shellfish bed. Sampling was repeated eight to 10 times for each point. Shellfish samples were collected on 3 separate days from each bed in the Bay. Three samples were collected on one day from the control bed.

Analyses for total and fecal coliform bacteria were performed in accordance with (1) Recommended Procedures for the Examination of Sea Water and Shellfish, 1970, and (2) Standard Methods, 1971. The most probable number (MPN) technique was employed, using five tubes per dilution.

Enrichments for Salmonella organisms were prepared as follows. Ten grams of shellfish meat (suspended in buffered dilution water and homogenized) was added to each of six flasks, three containing Tetrathionate Broth (Difco), and three containing Selenite Broth (Difco). A set of broths was then incubated at each of three temperatures: 37°, 41.5°, and 43°C. On 3 to 5 successive days, a sample from the contents of each flask was streaked onto XLD (Difco) and Brilliant Green (Difco) Agar plates. Colonies with morphologies typical of Salmonellae were isolated in pure culture, transferred to Brain Heart Infusion (BHI, Difco) slants, gramstained, and screened for biochemical reactions in Enterotubes (Roche Diagnostics). Biochemical characters observed in the Enterotubes were: fermentation of dextrose, dulcitol, and lactose; production of hydrogen sulfide and indole, phenylalanine deaminase, urease, and lysine decarboxylase; and citrate utilization. Isolates giving physiological reactions typical of Salmonella reaction patterns were screened for serological reacations with Salmonella Vi and somatic group antisera (Difco).



LOCATION OF SHELLFISH BEDS
MICROBIOLOGICAL
and
CHEMICAL ASSESSMENTS
San Francisco Bay, 1972

Figure 1

TABLE I.--Identification Number and Description of Shellfish Beds, Microbiological and Chemical Assessments, San Francisco Bay, 1972.

Station Number	Description*
3	Bayview Park
9	Burlingame
10	Coyote Point, north of
14	Foster City
19	Oakland Airport
20	San Leandro Bay
22	Alameda Memorial State Beach
23	Oakland Inner Harbor
27	Albany Hill
29	Point Richmond
30	Castro Point
31	Tara Hills, left
32	Tara Hills, middle
33	Tara Hills, right
41	Strawberry Point, west side
42	Richardson Bay, north end
Control	Johnson Oyster Company, Drake's Estero

*Descriptions are adapted from Wooster (1968).

Positive cultures were sent to the State of California, Department of Health, for final typing and identification.

Initial screening for Salmonellae was performed by the fluorescent antibody (FA) technique. Plates were prepared (XLD and Brilliant Green Agars) from enrichment broths after 18 to 24 hours incubation. The inoculated plates were incubated 2 to 3 hours, and colony smears were made on FA slides. The slides were then stained with FA Salmonella Panvalent Serum (Difco) and examined under a Leitz Fluorescence microscope. Salmonella enrichment procedures were discontinued for those samples giving less than 3+ fluorescence.

A chain of custody was maintained for each sample. The data books show the sample tags and the names of sample collectors and processors.

Samples were iced in transit. Water samples were processed within 3 hours of collection, and shellfish within 4 hours. Temperatures of incubation were 35°± 0.5°C for total coliforms and 44.5± 0.2°C for fecal coliforms. A recording thermometer was used to monitor the covered circulating water bath used for fecal coliform incubation.

The shellfish sampled were littleneck and soft shell clams and oysters. Oysters were gathered only at Station 10 (Coyote Point) and at the Control Station. Clams were gathered at all other stations. No attempt was made to segregate the clam species.

Results and Discussion

Coliform values obtained during the study are summarized in Figures 2-4, and Tables 2.4. Values for each observation are found in Appendix B.

Bacterial standards for marketable shellfish (those intended for shipment via interstate commerce) are set in the National Shellfish Sanitation Program (1965). The State of California, as a participant in the National Shellfish Sanitation Program, also follows these standards. Limits of the standard for shellfish meat are:

> . . .fecal coliform density of not more than 230 MPN per 100 grams. . ..

For waters overlying the shellfish beds, the standard states:

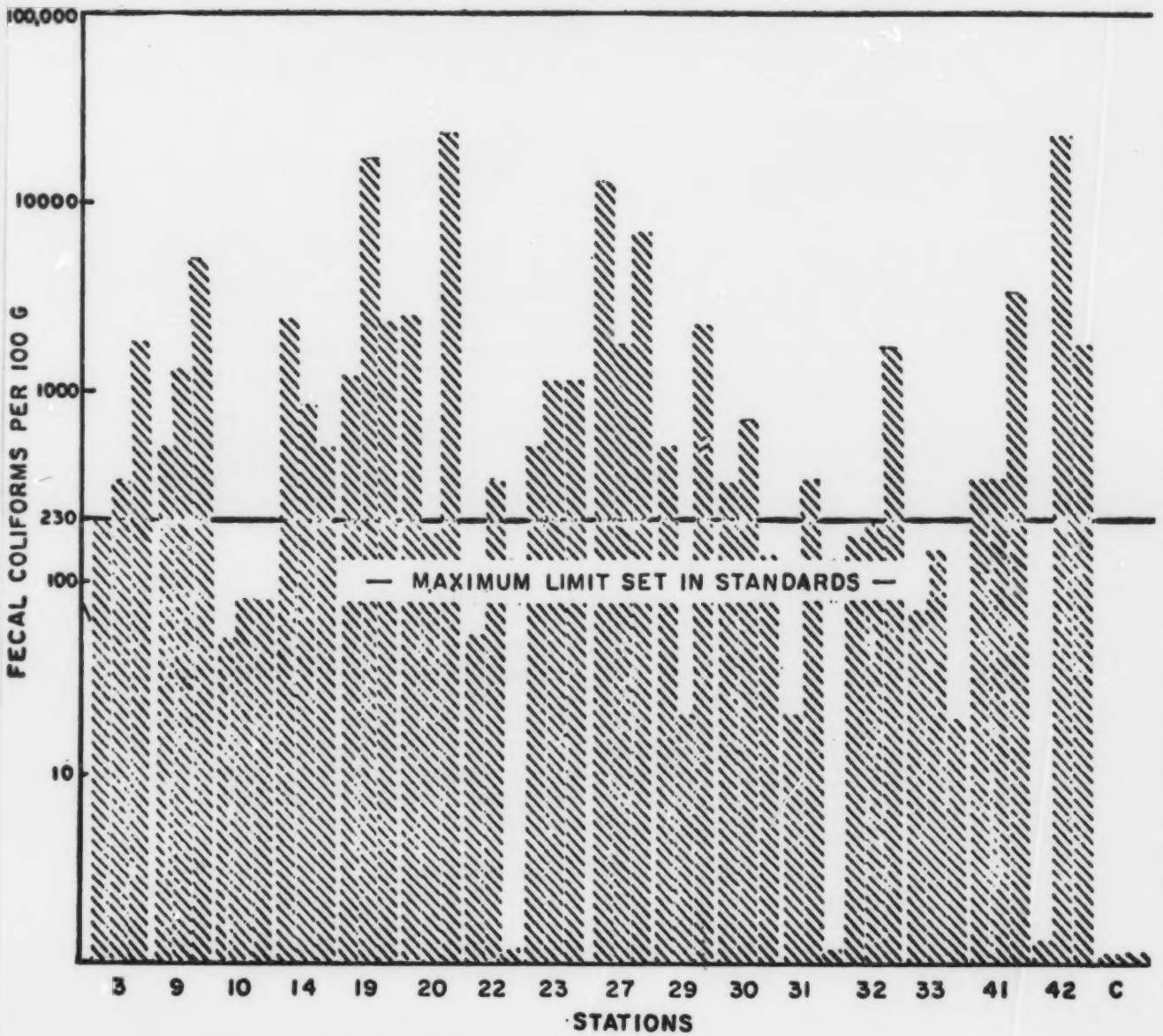
> The coliform median MPN of the water does not exceed 70 per 100 ml, and not more than 10 per cent of the samples ordinarily exceed an MPN of 230 per 100 ml for a 5-tube decimal dilution test. . .in those areas most probably exposed to fecal contamination during the most unfavorable hydrographic and pollution conditions. . ..

Figure 2 and Table 2 show the fecal coliform levels found in shellfish at each station. As seen in Figure 2, six stations out of the 16 total showed violation of the standards 100 per cent of the time: Burlingame (9); Foster City (14); Oakland Airport (19); Oakland Inner Harbor (23); Albany Hill (27); and Strawberry Point (41). Five stations showed violations two times out of three: Bayview (3); San Leandro Bay (20); Point Richmond (29); Castro Point (30); and Richardson Bay (42). Three stations showed one violation: Alameda (22); Tara Hills, left (31); and Tara Hills, middle (32). Three stations had no violations during the sample period: Coyote Point (10); Tara Hills, right (33); and the Control.

As seen in Table 2, San Leandro Bay (20) and Richardson Bay (42) showed high values of 23,000 fecal coliforms per 100 gm shellfish meat. This exceeds the standard (230 FC/100 gm) by a factor of 100 times. Salmonella organisms, pathogenic bacteria, were isolated from two stations sampled: Salmonella kentucky was found at Burlingame (9), and S. typhimurium at San Leandro Bay (20). The lack of recovery of similar organisms from other beds, however, does not automatically mean these beds were not contaminated, but possibly that the recovery procedure did not succeed.

Figure 3 and Table 3 show the median total coliform values in water overlying the shellfish beds. Violations of standards (median equal to, or less than 70/100 ml) were found at four stations: Oakland Airport (19); San Leandro Bay (20); Castro Point (30); and Richardson Bay (42), (Figure 3).

Figure 4 and Table 3 show the percent of water samples exceeding the maximum allowable total coliform limit, (no more than 10 percent of the samples shall exceed 230/100 ml). Violations of standards occurred at nine out of 16 stations: Burlingame (9); Coyote Point (10); Foster City (14);



FECAL COLIFORM LEVELS IN SHELLFISH MEATS
BY STATION, APRIL 7-23, 1972

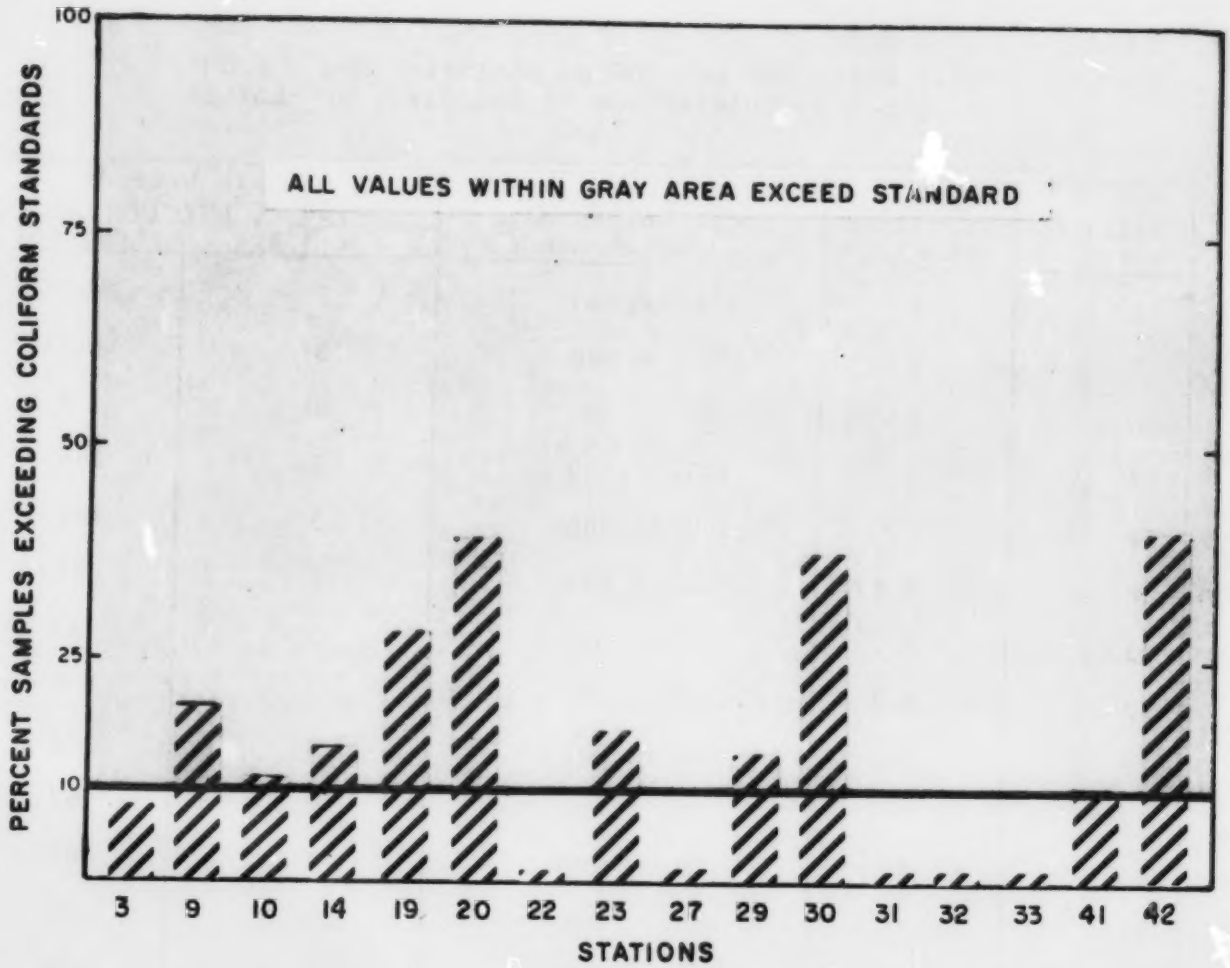
Figure 2

TABLE 2.--Fecal Coliforms per 100 gm Shellfish Meat: Range of Values and Comparison to Standard, by Station.

Station No.	No. Times Sampled	Fecal Coliforms per 100 gm Range	Sample Exceeds 230 FC per 100 gm	
			No. Times	Percent
3	3	230- 1,700	2	67
9	3	490- 4,900	3	100*
10	3	50- 80	0	0
14	3	490- 2,300	3	100
19	3	1,100-17,000	3	100
20	3	170-23,000	2	67†
22	3	<20- 330	1	33
23	3	490- 1,100	3	100
27	3	1,700-13,000	3	100
29	3	20- 1,400	2	67
30	3	110- 700	2	67
31	3	<20- 330	1	33
32	3	170- 1,700	1	33
33	3	20- 130	0	0
41	3	330- 3,300	3	100
42	3	<20-23,000	2	67
Control	3	<2- 13	0	0

*Salmonella kentucky isolated.

†Salmonella typhimurium isolated.

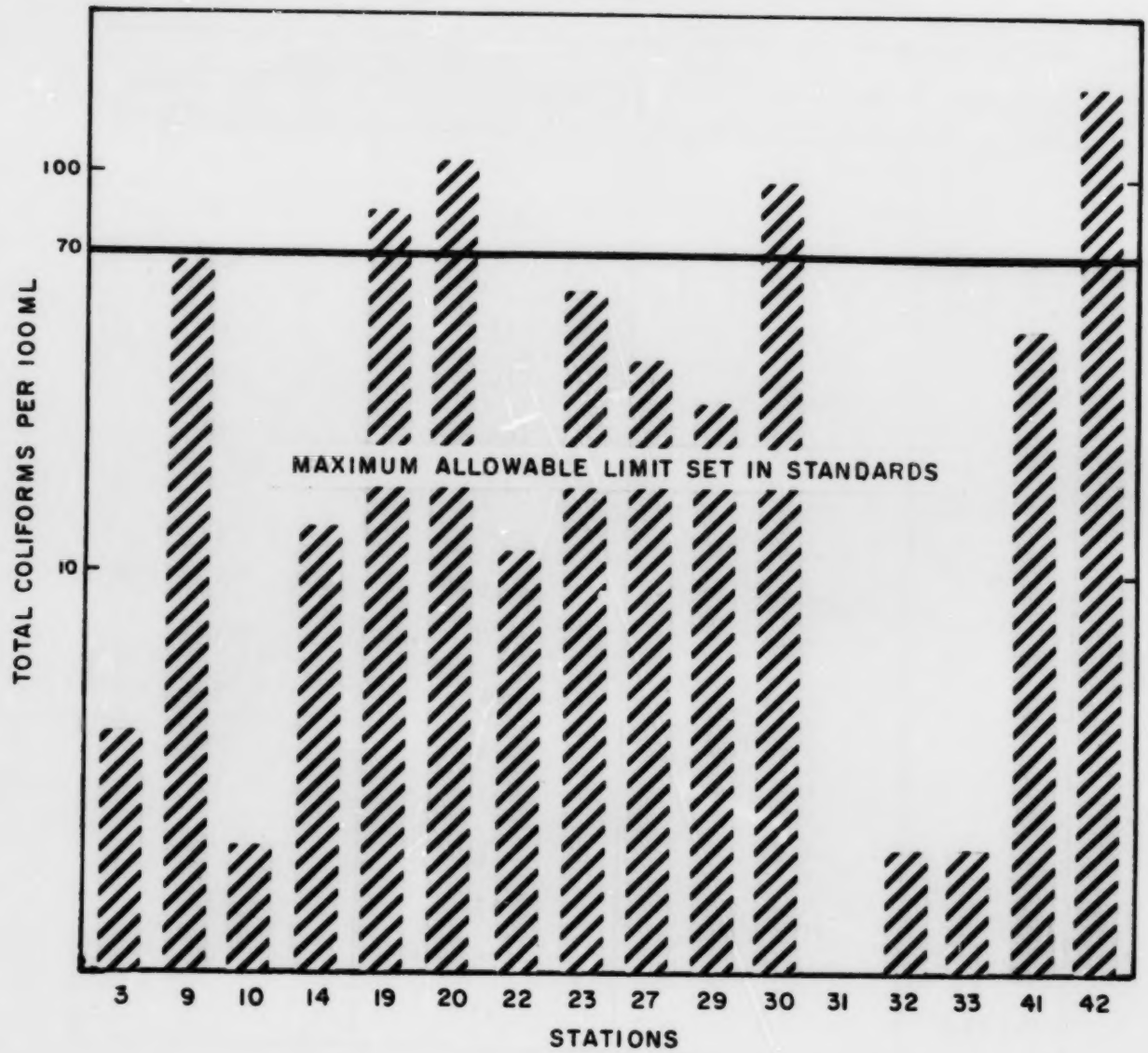


WATER OVERLAYING SHELLFISH BEDS, SF BAY, BY STATION:
PERCENT WHICH EXCEEDS STANDARDS, APRIL-MAY, 1972

Figure 3

Table 3.--Total Coliforms in Water Overlying Shellfish Beds: Median Values per 100 ml and Percent Exceeding 230 per 100 ml, by Station.

Station No.	No. Observations	Total Coliforms	
		Median per 100 ml	Percent above 230 per 100 ml
3	27	4	7
9	29	59	21
10	27	2	11
14	27	13	15
19	24	79	29
20	30	104	40
22	27	11	0
23	30	50	17
27	30	33	0
29	30	25	13
30	30	94	37
31	30	1	0
32	30	2	0
33	30	2	0
41	30	63	10
42	30	170	40
Control	3	<2	0



MEDIAN TOTAL COLIFORM NUMBERS PER 100ML
WATER SAMPLES BY STATION, SF BAY, APRIL – MAY, 1972

Figure 4

Oakland Airport (19); San Leandro Bay (20); Oakland Inner Harbor (23); Point Richmond (29); Castro Point (30); and Richardson Bay (42). Four of these stations (19, 20, 30, 42) also exceeded the median total coliform limit per 100 ml (Figure 3).

Table 4 shows, by station, the correlation between violations of the shellfish meat standard and violations of the overlying water standards. Shelllfish meat from 14 out of 16 stations exceeded the bacterial standards at least once.

a) Four stations showed violations in all three shellfish samples with a concomitant violation of at least one water standard, (upper limit of 230 TC/100 ml exceeded more than 10 percent of the time). These stations were: Burlingame (9); Foster City (14); Oakland Airport (19); Oakland Inner Harbor (23). Oakland Airport (19) showed an additional violation of the other water standard, (median TC not to exceed 70/100 ml).

b) Three stations exceeded the shellfish meat limit two times (out of three) with concomitant violations of both water standards: San Leandro Bay (20); Point Castro (30); and Richardson Bay (42). One station, Point Richmond (29), had violations in two shellfish meat samples and in only one of the water standards (the percent limit).

c) Three stations exceeded the shellfish meat limit one time, with no violations of either water standard: Alameda (22); Tara Hills, left (31); and Tara Hills, middle (32).

d) One station showed violation of one water standard (the percent limit) but no violation of shellfish meat limits: Coyote Point (10).

e) One station, Tara Hills, right (33), and the Control showed no violations for shellfish meat or for overlying water standards.

TABLE 4.--Relationships Between Number of Violations in Shellfish Meat and Number of Violations of the Two Water Standards, By Station.

No. Times Shellfish Meat Exceeded Standards			
Three Times	Two Times	One Time	No Time
Sta 9*	Sta 3	Sta 22	Sta 10*
14*	20*†	31	33
19*†	29*	32	Control
23*	30*†		
27	42*†		
41			

*Concomitant violation of Water Standard "not more than 10% of samples exceed 230 total coliform/100 ml".

†Concomitant violation of Water Standard "median total coliform not to exceed 70/100 ml".

IV. CHEMICAL ASSESSMENT

Introduction

Although the National Shellfish Sanitation Program currently has no standards set for concentrations of heavy metals or chlorinated hydrocarbons in shellfish meat, standards for some parameters have been set by the Food and Drug Administration for certain foods. Tests were conducted to determine the existing level of heavy metals found in San Francisco Bay shellfish, and to compare these levels with existing food standards. Chemical assessments were performed to determine concentrations of: cadmium, chromium, copper, lead, mercury, zinc, and chlorinated hydrocarbons.

Methods

Samples undergoing analyses for heavy metals were subjected first to wet digestion and then to analyses by atomic absorption spectrophotometry, using the Perkin-Elmer 403. Spectrophotometry was in accordance with EPA procedures (1971).

For wet digestion, the following procedures were followed. A weighed sample was suspended in a solution of 10 ml redistilled, concentrated nitric acid plus 1 ml hydrogen peroxide. Digestion proceeded in a sand bath at 60° C until tissue dissolved; the temperature was then gradually increased to 95° C. The volume was evaporated to 2 - 3 ml. One ml distilled, concentrated hydrochloric acid was added and digestion continued for 15 minutes at 95°C. The contents were cooled slightly and quantitatively transferred with warm (50°C) 1 percent nitric acid into a 25 ml volumetric flask. After cooling, the digested material was brought up to volume with an additional 1 percent nitric acid. There was no filtration step. The material was then ready for analysis.

To insure quality control, precision (duplicates) and accuracy (spikes) checks were performed. About 25 percent of the samples were spiked with known amounts of selected heavy metals. Recovery (or accuracy) ranges were: cadmium, 88.8-101 percent; chromium, 93.0-106 percent; copper, 96.4-102 percent; lead, 88.7-104 percent; mercury, 65-106.5 percent, (the three values in the range were 65, 99.2 and 106.5 percents, with 65 percent recovery occurring in a very low level spike of the control sample); and zinc, 95.0-99.8 percent.

Chlorinated hydrocarbons were determined by gas chromatographic procedures (EPA, 1971). The following steps

were used: hexane/isopropanol extraction; hexane/acetonitrile liquid-liquid partition; Florisil fractionation; and identification and quantitation by both multicolumn electron capture and microcoulimetric gas chromatography, using a Microtek MT-220.

Results and Discussion

Table 5 shows the wet weight levels of selected heavy metals for each shellfish bed. The following ranges (in PPM, or mg/kg) were observed in samples of shellfish meat from the 16 stations and the Control: cadmium, 0.06-1.41; chromium, 0.10-6.65; copper, 1.12-48.2; lead, 0.23-18.7; mercury, 0.01-0.15; and zinc, 8.48-157. These values generally fall within the ranges observed by Pringle, Hissong, Katz and Mulawka (1968) in selected clams and oysters found on the East and West Coasts of the United States. However, the lead levels reported at Bayview (3), 10.5 PPM, and at Albany Hill (27), 18.7 PPM, exceeded the upper limit reported by Pringle, et al., of 10.2 PPM in softshell clams.

The Food and Drug Administration has established tolerance guidelines for certain heavy metals in a variety of foods. The recommended tolerance limit for lead in food is 7 PPM. Again, this level was exceeded at two stations: Bayview (3), 10.5 PPM, and Albany Hill (27), 18.7 PPM.

The FDA recommended guideline for cadmium in food is 0.5 PPM. According to Nilsson (Metals and Ecology, 1969), cadmium accumulated by humans is almost never excreted and can cause both acute and chronic poisonings. Shellfish meat from two stations exceeded guidelines for cadmium; Oakland Inner Harbor (23) had a cadmium value of 0.58 PPM, and Coyote Point (10), 1.41 PPM. All of the other shellfish beds had cadmium levels below 0.5 PPM.

The FDA recommended guideline for mercury in food is 0.5 PPM. All values observed during the study fell below this limit.

There is no established guideline for zinc. During the study, values observed in clams ranged from 8.48-35.1 PPM. For oysters, higher levels were observed: Control, 57.6 PPM; and Coyote Point (10), 157 PPM. Pringle, et al. (1968) state that oysters tend to concentrate zinc, so that a range of 800-1000 PPM zinc would be considered normal.

Table 6 lists the concentration of selected chlorinated hydrocarbons (wet weight) by shellfish bed. Included are pesticides (dieldrin and metabolites of DDT) and PCB's (Arochlor 1242, 1254).

TABLE 5.--Concentration of Selected Heavy Metals, Wet Weight, By Station

EPA Lab Number	Coll. Date	Sample Description	Concentration, Wet Weight in mg/Kg					
			Cadmium	Chromium	Copper	Lead	Mercury	Zinc
16SF042	4/7/72	#3/Bayview	0.21	2.62	5.73	10.53	0.03	18.71
5SF042	4/7/72	#9 Burlingame	0.15	0.88	1.20	1.32	0.01	8.48
15SF042	4/7/72	#10 Coyote Pt.-N	1.41	0.79	48.19	1.75	0.15	156.63
6SF042	4/7/72	#14 Foster City	0.12	0.30	1.38	0.41	0.03	10.47
7SF042	4/7/72	#19 Oakland Airport	0.13	0.53	1.12	0.42	0.02	9.30
8SF042	4/7/72	#20 San Leandro Bay	0.33	0.56	1.34	1.22	0.02	10.62
14SF042	4/8/72	#22 Alameda Mem. State Park	0.35	1.17	1.98	0.93	0.05	24.03
13SF042	4/7/72	#23 Oakland Inner Harbor	0.58	0.67	1.21	3.82	0.06	35.05
28SF042	4/8/72	#27 Albany Hills	0.21	3.64	6.60	13.70	0.06	24.53
36SF042	4/8/72	#29 Pt. Richmond	0.25	0.31	1.94	0.71	0.09	20.25
35SF042	4/8/72	#30 Castro Pt.	0.06	0.84	1.25	0.23	0.03	9.11
29SF042	4/8/72	#31 Tara Hills (L)	0.14	1.70	2.47	1.53	0.04	17.41
30SF042	4/8/72	#32 Tara Hills (M)	0.09	6.65	4.66	1.84	0.09	14.93
31SF042	4/8/72	#33 Tara Hills (R)	0.06	3.99	2.62	2.17	0.05	14.60
33SF042	4/8/72	#41 Strawberry Pt.-W	0.29	1.47	4.05	1.79	0.06	19.32
32SF042	4/8/72	#42 Richardson Bay	0.16	2.96	3.52	2.92	0.06	18.27
Control	5/23/72	Johnson Oyster Co. Drake's Estero	0.33	0.10	2.03	0.93	0.04	57.57

TABLE 6.--Concentration, in PPB, of Selected Chlorinated Hydrocarbons by Station, San Francisco Bay Study, April - May 1972

Chlorinated Hydrocarbon	STATION *																	
	3	9	10	14	19	20	22	23	27	29	30	31	32	33	41	42	C_1†	C_2†
Arochlor 1242, 1254	26.5	10.5	446.	23.8	91.0	75.0	64.7	119.	88.0	252.0	25.9	25.4	37.8	39.4	18.0	29.1	4.7	3.8
Dieldrin	-§	0.9	2.8	0.9	1.2	1.0	1.0	0.4	4.0	-	-	1.0	1.2	0.8	-	0.6	-	-
pp' DDE	4.2	7.2	28.0	1.9	4.3	5.5	5.8	4.0	7.2	1.6	1.4	2.2	7.0	3.4	2.2	1.8	1.2	tr
op' DDE	1.3	4.4	13.0	0.8	2.0	3.5	2.9	2.1	2.0	1.2	1.3	0.8	1.7	2.0	2.0	1.9	2.6	2.1
op' DDD	-	tr‡	-	-	-	-	-	-	1.2	tr	tr	tr	-	tr	-	tr	-	-
op' DDT	1.2	3.6	22.0	0.8	2.3	8.0	2.4	1.0	1.6	0.4	0.5	0.4	-	1.2	0.9	0.7	1.8	1.3
pp' DDD	1.1	3.6	7.0	0.5	1.7	2.5	1.4	2.0	2.8	1.2	1.2	1.2	1.7	2.2	0.9	0.7	1.2	0.6
pp' DDT	2.3	4.8	24.0	1.1	3.0	3.5	2.4	2.0	3.6	1.0	1.2	0.6	0.8	1.6	0.3	1.3	-	-
Unknown	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.8	2.2

*For Station location, see Table 1 and Figure 1.

Dates of Collection:

7 April, 1972 - #3, 9, 10, 14, 20, 22, 31
8 April, 1972 - #23, 29, 30, 32, 33
17 April, 1972 - #19
18 April, 1972 - #41, 42
20 April, 1972 - #27
23 May, 1972 - C_1, C_2

† C_1 and C_2 are reference samples for Johnson Oyster Co.
‡ tr = trace amount (less than 1.0 ppb).
§ - means none detectable.

Concentrations of chlorinated hydrocarbons found in shellfish were below the most restrictive FDA guidelines for food. According to FDA guidelines, tolerance limits for PCB's vary depending upon the kind of food contaminated. For example, values above 0.5 PPM in eggs, 5.0 PPM in fish, and 5.0 PPM in chicken, are all considered potentially hazardous.* The highest level observed during the Bay study was 0.446 PPM at Coyote Point (10), a level still below the most restrictive tolerance limit.

Recent studies (Duke, Lowe, Wilson, 1970) have indicated that under test conditions low levels of PCB's (1.0 PPB) can inhibit shell development in oysters. Whether or not this effect has occurred at Coyote Point (10), was not determined by this study.

Tolerance limits for DDT and its metabolites are set at 7 PPM for certain agricultural products and at 0.05 PPM for milk. Values for all the shellfish meat tested were below 0.05 PPM.

*Eggs have the lowest tolerance limits because they are consumed in quantity by infants.

V. BIOLOGICAL ASSESSMENT

Introduction

Samples of clams were collected from 19 shellfish beds in San Francisco Bay in order to appraise the changes in clam density and size which have occurred between 1967 and 1972. The 1967 data used was collected by Wooster (1968). The species of clams compared were those most commonly encountered by the Bay sportsman: Mya arenaria (softshell clam) and Tapes semidecussata (Japanese little neck).

Methods

Nineteen of the 42 shellfish beds previously surveyed by Wooster were sampled for species composition and density, following his prescribed methods. This involved taking a square foot of substrate to a depth that would include all available shellfish, and placing the material in a wooden-frame sampler with a 1/4-inch hardware cloth bottom. By shaking the sampler in water, the sand, mud and small gravel were removed, retaining larger material along with any clams. The shellfish from each square foot of sample were then placed in a plastic bag and taken to the laboratory. Each shellfish was measured for size, and all shellfish of the same species were combined to obtain a total weight for each sample.

"Angler" days were calculated by dividing the number of legal-sized clams found in the bed by 50, the daily allowable limit.

Results and Discussion

A summary of the results of the clam survey is given in Table 7. It shows the average weight in grams per square foot, total weight of clams in kilograms, and total "angler" days recorded for the 19 shellfish beds during both the 1967 and 1972 surveys. The results are based on 105 samples taken in 1967 and 125 samples in 1972. They show a decline in shellfish mass and number of legal-sized clams over the 5 year period: a loss of 83 grams average weight per square foot of shellfish bed area; a loss of 330,400 kilograms total weight; and a loss of 210,300 "Angler" days. The magnitude of the decline has been a 42 percent loss in mean grams of clam weight per square foot of shellfish bed area, 50 percent loss in legal-sized clams, and 53 percent loss in total weight of clams in kilograms. A more extensive analysis of this data is on file at the EPA, Region IX, Surveillance and Analysis Division.

TABLE 7.--Comparison of Clam Densities and Weight, and "Angler" Days, in 19 Selected Beds, 1967 and 1972.

Date	No. of Samples	Avg. Wt. gm/ft^2*	Total Wt Kg†	Total "Angler" Days§
1967	105	196	618000	418900
1972	125	113	287600	208600
Absolute Loss		83	330400	210300
Percentage Decrease		42%	53%	50%

* Average weight of clams, in grams, per square foot of shellfish bed area.

† Total estimated weight, in kilograms, of all clams in the 19 shellfish beds sampled.

§ "Angler" days is the legal limit for sportsmen, 50 clams, 38mm in length.

The 19 beds surveyed for clam density and biomass comprise 95 percent of the total area listed and sampled by Wooster (42 beds), who attempted to survey all existing shellfish beds in the Bay. It is improbable, however, that Wooster was able to sample all clam beds in the periphery of San Francisco Bay since some are inaccessible and remain underwater even at low tide.

VI. REFERENCE MATERIAL

APPENDIX A

STATION LOCATIONS

SHELLFISH BED LOCATIONS

#3/Bay View Park

Driving north on Bayshore (U.S. 101), take "Candlestick Park" turnoff. Pull off road at culvert outflow. Bed location begins here and runs north.

#9/Burlingame

Proceed north on Bayshore (U.S. 101). About 0.5 miles beyond Coyote Point, on right side of road is an enclosed lagoon. Bed is situated in this lagoon.

#10/Coyote Point, North of

Take East Peninsula Avenue into Coyote Point Park. Turn left at Castaway and drive into parking lot. Proceed to end of lot, facing toward the freeway. Bed is situated along the entire beach, approximately one mile.

#14/Foster City

After crossing San Mateo Bridge (driving southwest), take first road to the right. Circle back and park on right of bridge. Walk under bridge. Bed extends in a large area from remnants of the old San Mateo Bridge, south.

#19/Oakland Airport

Follow Oakland Airport Drive. Turn left at first Standard Oil Service Station and right at first dirt road. Bed is situated along inlet to the west.

#20/San Leandro Bay

In Alameda, follow Otis Drive and proceed toward Oakland Airport. After crossing bridge to Bay Farm Island, the road becomes Doolittle Drive. Continue to a point where the water (San Leandro Bay) ends on the left, (wire fence will also end). Bed stretches from corner of fence, back about 100 yards.

#22/Alameda Memorial State Park

In Alameda, turn from Central Avenue onto McKay Street (Federal Center) and proceed to road's end. Bed is situated around point of land, starting on the beach section, even with end of McKay Street.

#23/Oakland Inner Harbor, at foot of Alice St.

From Alameda, drive north on Webster Street through Posey Tube and turn right onto Seventh Street. Turn right at Jackson and drive under freeway (HWY 17). Turn right on Fourth Street to Alice Street, and left on Alice to end of street. Bed is located partially under old piers, which extend about 100 yards to the left (of Alice Street).

#27/Albany Hill

Proceed north on State HWY 17/Interstate 80. Take "HWY 17" turn-off toward Richmond (Hoffman Boulevard). Bed is located between Central Avenue and Golden Gate Fields.

#29/Point Richmond

Proceed north and northwest on State HWY 17 toward Richmond-San Rafael Bridge. Take Garrard Boulevard left (toward Richmond Plunge) and go through the tunnel. Park along side of road at Keller Cove Park. Bed is located along entire cove, from Ferry Point to Cypress Point.

#30/Castro Point, et al.

Proceeding northwest on State HWY 17, take "Pt. Molate" turnoff. Drive past U.S. Government Guard Station and continue to end of road. Beds are located in several coves. The station location includes Castro Point, Point Molate, Point Orient, and Point San Pablo.

#31, 32, 33/Tara Hills

Follow San Pablo Avenue to Tara Hills Boulevard in Pinole. Turn left. Immediately turn onto small road leading to San Pablo Waste Water Treatment Plant. Walk over railroad track (near small creek). Bed #32 is delineated by an old fence. Beds #31 and #33 are south and north of #32.

#41/Strawberry Point

Proceed north on U.S. 101. Take Strawberry Point Road (Seminary Drive) and follow until approaching near water. Clam beds are located at bend and in cove. At east end of bed, posts are visible in the water. An access path is located at this east end.

#42/Richardson Bay

Bed is located under north end of U.S. 101 bridge which spans Richardson Bay. Bed extends eastward from the bridge piers.

WATER STATIONS

Sta 3 - Bay View (boat) - inlet

A. Opposite piling. Brown building, left edge, lines up with apartment building, left edge.

B. Opposite storm drain.

C. Opposite water tank - "C" in Cow Palace sign and telephone pole line up.

Sta 9 - Burlingame (foot) - water's edge

A. Pile of rocks opposite grove of eucalyptus.

B. Between three towers and eucalyptus.

C. Storm drain.

Sta 10 - Coyote Point North (boat)
Line-Coyote Point and white billboard

A. (Rt.) Three tower poles line up - line up with Pirelli Tire Building.

B. (Middle) Opposite group of four cement piers, three tower poles line up.

C. (Left) Three tower poles line up.

Sta 14 - Foster City (boat)
Line-bridge facing south sixth pier

A. Line up power line piers (second framed by first).

B. Two telephone poles line up.

C. Power towers line up.

Sta 19 - Oakland Airport (boat)
Line-end of pier and tower

A. Stack on shack lines up with ball dome on hill.

B. Yellow marker lines up with clump of trees (above dump).

C. Left corner of flat yellow roof is at right edge of right gray cover above pumps.

Sta 20 - San Leandro Bay (foot) - water's edge

A. End of pier.

B. Line up with fence.

C. Point of land by sand blast; line up telephone pole nest to billboard with power pole behind (on green building).

Sta 22 - Alameda Memorial State Beach (foot) -water's edge
Shell fish from cove

A. West point.

B. Center of cove.

C. East point.

Sta 23 - Oakland Inner Harbor (foot) - water's edge

A. Last elevated piling (line up with edge of brick building).

B. Line up with first fallen log from fence and sign "Slow" across estuary.

C. Foot of Alice Street marker.

Sta 27 - Albany Hill (boat)
Line-point of land beyond towers

A. Two telephone poles line up beige building between.

B. Campanile (U.C. Berkeley campus) lines up with duck blind.

C. Right side duck blind lines up with right side of pink house on hill.

Sta 29 - Point Richmond (foot) - water's edge

A. By casing.

B. Point with riprap.

C. Rocky point; spire on Golden Gate Bridge is centered between two hills.

Sta 30 - Castro Point, et al. (foot) - water's edge

A. Edge of piling.

B. Middle of bed-walls.

C. Point of land extending.

LINE FOR STA 31, 32, 33 - tall smoke stack ahead, clump of trees on point.

Sta 31 - Tara Hills (boat)

A. On turquoise building, the center vent lines up with telephone pole.

B. Pink tanks on hill line up.

C. In second row, white houses line up.

Sta 32 - Tara Hills (boat)

A. Black pole lines up with right edge of first projection on red roof.

B. Middle tower on hill lines up with right edge of red roof.

C. Middle tower and left edge of red roof line up.

Sta 33 - Tara Hills (boat)

A. Water tower lines up with "V" in hills (right).

B. White sign lines up with right edge green house.

C. Back pink tank, right edge, lines up with left edge of front pink tank.

Sta 41 - Strawberry Point (foot) - water's edge

A. Water's edge by large boulder on beach.

B. Opposite acacia tree.

C. Left pole in water lines up with right tank on fill; station is opposite pipe in road.

Sta 42 - Richardson's Bay (foot) - water's edge

A. Point of land toward marker.

B. Center of bed.

C. Piers for bridge (3rd from left).

APPENDIX B

BACTERIOLOGICAL DATA

SAN FRANCISCO BAY SHELLFISH STUDY

Bacteriological Tests of Shellfish

FECAL COLIFORM, MPN/100 gm

Shellfish Bed Location and Number	DATE SAMPLED 4/7-8/72	4/17-18/72	4/22-23/72	5/23/72
Bayview (3)	230	330	1,700	
Burlingame (9)	490	1,300	4,900	
Coyote Point (10)	50	80	80	
Foster City (14)	2,300	790	490	
Oakland Airport (19)	1,100	17,000	2,200	
San Leandro Bay (20)	2,300	170	23,000	
Alameda (22)	50	330	<20	
Oakland Inner Harbor (23)	490	1,100	1,100	
Albany Hills (27)	13,000	1,700	7,000	
Pt. Richmond (29)	490	20	1,400	
Pt. Castro (30)	330	700	110	
Tara Hills No. 1 (31)	20	330	<20	
Tara Hills No. 2 (32)	170	230	1,700	
Tara Hills No. 3 (33)	70	130	20	
Strawberry Pt. (41)	330	330	3,300	
Richardson Bay (42)	<20	23,000	1,700	
Johnson Oyster Co., Drake's Estero -- Control				
Station A				2
Station B				13
Station C				<2

Source: EPA Laboratory, Region IX

SAN FRANCISCO BAY SHELLFISH STUDY

Bacteriological Tests of Overlying Waters

Shellfish Bed Location and Number: Bayview (3)

COLIFORM, MPN/100 ML

Date Sampled	STATION A		STATION B		STATION C		Remarks
	Total, Confirmed	Fecal	Total, Confirmed	Fecal	Total, Confirmed	Fecal	
4/19/72	2	<2	5	<2	<2	<2	
4/21/72	<2	<2	<5	<2	4	<2	
4/25/72	5	5	33	4	350	130	
4/26/72	<2	<2	<2	<2	<2	<2	
4/27/72	350	110	2400	490	130	33	
4/28/72	<2	<2	2	<2	2	2	
5/1/72	110	49	79	23	240	130	
5/2/72	<2	<2	5	2	5	2	
5/3/72	<2	<2	4	4	2	<2	

Source: EPA Laboratory, Region IX

SAN FRANCISCO BAY SHELLFISH STUDY

Bacteriological Tests of Overlying Waters

Shellfish Bed Location and Number: Burlingame (9)

COLIFORM, MPN/100 ML

Date Sampled	STATION A		STATION B		STATION C		Remarks
	Total, Confirmed	Fecal	Total, Confirmed	Fecal	Total, Confirmed	Fecal	
4/19/72	49	8	17	4	14	8	
4/21/72	<4	<2	17	17	130	17	
4/25/72	49	8	21	8	110	4	
4/26/72	8	2	33	5			
4/27/72	2	<2	2	2	17	17	
4/28/72	13	2	110	13	220	49	
5/1/72	220	23	1100	49	49	<2	
5/2/72	460	90	22	8	920	350	
5/3/72	70	2	330	22	92,000	490	
5/4/72	79	2	240	<2	33	5	

Source: EPA Laboratory, Region IX

SAN FRANCISCO BAY SHELLFISH STUDY

Bacteriological Tests of Overlying Waters

Shellfish Bed Location and Number: Coyote Pt. (10)

COLIFORM, MPN/100 ML

Date Sampled	STATION A		STATION B		STATION C		Remarks
	Total, Confirmed	Fecal	Total, Confirmed	Fecal	Total, Confirmed	Fecal	
4/19/72	490	2	1700	13	1100	13	
4/21/72	<2	<2	2	<2	<2	<2	
4/25/72	<2	<2	2	<2	<2	<2	
4/26/72	<2	<2	<2	<2	<2	<2	
4/27/72	<2	<2	<2	<2	<2	<2	
5/1/72	14	<2	<2	<2	2	<2	
5/2/72	2	<2	2	<2	11	2	
5/3/72	2	<2	7	2	<2	<2	
5/10/72	5	<2	2	<2	<2	<2	

Source: EPA Laboratory, Region IX

SAN FRANCISCO BAY SHELLFISH STUDY

Bacteriological Tests of Overlying Waters

Shellfish Bed Location and Number: Foster City (14)

COLIFORM, MPN/100 ML

Date Sampled	STATION A		STATION B		STATION C		Remarks
	Total, Confirmed	Fecal	Total, Confirmed	Fecal	Total, Confirmed	Fecal	
4/19/72	330	130	330	230	790	790	
4/21/72	2	2	22	7	130	49	
4/25/72	540	540	49	49	13	13	
4/26/72	8	<2	33	8	2	<2	
4/27/72	<2	<2	2	<2	13	2	
5/1/72	8	2	33	17	13	13	
5/2/72	17	17	23	13	11	11	
5/3/72	4	4	2	2	7	2	
5/10/72	13	13	8	<2	<2	<2	

Source: EPA Laboratory, Region IX

SAN FRANCISCO BAY SHELLFISH STUDY

Bacteriological Tests of Overlying Waters

Shellfish Bed Location and Number: Oakland Airport (19)

COLIFORM, MPN/100 ML

Date Sampled	STATION A		STATION B		STATION C		Remarks
	Total, Confirmed	Fecal	Total, Confirmed	Fecal	Total, Confirmed	Fecal	
4/19/72	79	7	79	8	350	27	
4/21/72	79	49	79	170	130	33	
4/27/72	8	8	49	17	13	5	
5/1/72	49	5	13	2	49	2	
5/2/72	170	70	4900	700	4600	1600	
5/3/72	3300	2300	3300	1300	1100	460	
5/10/72	170	79	790	170	4900	1300	
5/11/72	49	5	17	5	22	5	

Source: EPA Laboratory, Region IX

SAN FRANCISCO BAY SHELLFISH STUDY

Bacteriological Tests of Overlying Waters

Shellfish Bed Location and Number: San Leandro Bay (20)

COLIFORM, MPN/100 ML

Date Sampled	STATION A		STATION B		STATION C		Remarks
	Total, Confirmed	Fecal	Total, Confirmed	Fecal	Total, Confirmed	Fecal	
4/19/72	4	<2	11	2	31	31	
4/21/72	<2	<2	2	<2	330	330	
4/25/72	17	8	130	8	130	7	
4/26/72	49	11	2300	790	1700	330	
4/27/72	17	11	14	9	130	33	
5/1/72	33	4	2	<2	7	<2	
5/2/72	2300	490	4600	490	4900	460	
5/3/72	5	<2	79	8	33	2	
5/4/72	>240,000	92,000	92,000	11,000	>240,000	35,000	
5/10/72	35,000	5400	24,000	7900	3500	4900	

Source: EPA Laboratory, Region IX

SAN FRANCISCO BAY SHELLFISH STUDY

Bacteriological Tests of Overlying Waters

Shellfish Bed Location and Number: Alameda (22)

COLIFORM, MPN/100 ML

Date Sampled	STATION A		STATION B		STATION C		Remarks
	Total, Confirmed	Fecal	Total, Confirmed	Fecal	Total, Confirmed	Fecal	
4/19/72	<2	<2	4	2	11	7	
4/26/72	17	5	22	11	23	13	
4/27/72	8	5	13	13	2	2	
4/28/72	33	33	79	79	27	27	
5/1/72	5	2	5	2	2	2	
5/2/72	5	5	11	7	2	2	
5/3/72	<2	<2	17	4	5	<2	
5/4/72	5	5	23	8	13	8	
5/9/72	2	2	5	5	23	8	

Source: EPA Laboratory, Region IX

SAN FRANCISCO BAY SHELLFISH STUDY

Bacteriological Tests of Overlying Waters

Shellfish Bed Location and Number: Oakland Inner Harbor (23)

COLIFORM, MPN/100 ML

Date Sampled	STATION A		STATION B		STATION C		Remarks
	Total, Confirmed	Fecal	Total, Confirmed	Fecal	Total, Confirmed	Fecal	
4/19/72	230	22	49	11	49	17	
4/25/72	49	13	79	8	79	23	
4/26/72	79	79	170	110	240	13	
4/27/72	240	240	130	22	33	13	
5/1/72	49	13	22	22	350	130	
5/2/72	49	4	5	<2	240	22	
5/3/72	22	2	17	8	27	17	
5/4/72	49	8	350	70	110	79	
5/8/72	5	<2	11	4	13	2	
5/9/72	22	22	13	8	49	33	

Source: EPA Laboratory, Region IX

SAN FRANCISCO BAY SHELLFISH STUDY

Bacteriological Tests of Overlying Waters

Shellfish Bed Location and Number: Albany Hill (27)

COLIFORM, MPN/100 ML

Date Sampled	STATION A		STATION B		STATION C		Remarks
	Total, Confirmed	Fecal	Total, Confirmed	Fecal	Total, Confirmed	Fecal	
4/10/72	130	22	110	5	130	11	
4/14/72	5	<2	13	8	70	11	
4/16/72	33	4	70	<2	70	8	
5/8/72	33	8	5	5	14	2	
5/9/72	130	130	230	230	170	170	
5/11/72	33	13	79	11	2	<2	
5/12/72	5	5	7	4	2	2	
5/17/72	5	<2	5	<2	17	2	
5/18/72	130	5	79	13	49	7	
5/22/72	14	4	8	5	23	8	

Source: EPA Laboratory, Region IX

SAN FRANCISCO BAY SHELLFISH STUDY

Bacteriological Tests of Overlying Waters

Shellfish Bed Location and Number: Pt. Richmond (29)

COLIFORM, MPN/100 ML

Date Sampled	STATION A		STATION B		STATION C		Remark
	Total, Confirmed	Fecal	Total, Confirmed	Fecal	Total, Confirmed	Fecal	
4/10/72	2	2	<2	<2	2	2	
4/11/72	14	2	33	49	49	23	
4/12/72	5	<2	110	23	790	130	
4/13/72	79	13	170	130	17	2	
4/14/72	17	8	790	330	8	2	
5/5/72	23	2	5	<2	490	8	
5/8/72	13	5	2	2	8	5	
5/11/72	79	49	<2	<2	2	<2	
5/12/72	<2	<2	310	170	33	14	
5/15/72	46	46	110	70	70	49	

Source: EPA Laboratory, Region IX

SAN FRANCISCO BAY SHELLFISH STUDY

Bacteriological Tests of Overlying Waters

Shellfish Bed Location and Number: Pt. Castro (30)

COLIFORM, MPN/100 ML

Date Sampled	STATION A		STATION B		STATION C		Remarks
	Total, Confirmed	Fecal	Total, Confirmed	Fecal	Total, Confirmed	Fecal	
4/10/72	140	70	31	23	33	5	
4/11/72	49	9	22	5	49	5	
4/12/72	700	230	130	49	220	11	
4/13/72	170	5	140	14	79	8	
4/14/72	330	11	230	33	130	17	
5/5/72	16,000	9200	24,000	16,000	3500	3500	
5/8/72	1300	330	700	700	49	49	
5/11/72	79	49	11	5	23	8	
5/12/72	240	27	49	49	79	49	
5/15/72	540	70	350	79	240	49	

Source: EPA Laboratory, Region IX

SAN FRANCISCO BAY SHELLFISH STUDY

Bacteriological Tests of Overlying Waters

Shellfish Bed Location and Number: Tara Hills No. 1 (31)

COLIFORM, MPN/100 ML

Date Sampled	STATION A		STATION B		STATION C		Remark
	Total, Confirmed	Fecal	Total, Confirmed	Fecal	Total, Confirmed	Fecal	
4/10/72	2	2	<2	<2	<2	<2	
4/14/72	5	2	8	2	5	2	
4/16/72	5	<2	5	<2	17	2	
5/8/72	2	<2	<2	<2	<2	<2	
5/9/72	<2	<2	<2	<2	5	<2	
5/11/72	2	<2	<2	<2	2	<2	
5/12/72	<2	<2	<2	<2	<2	<2	
5/17/72	5	2	<2	<2	<2	<2	
5/18/72	<2	<2	<2	<2	<2	<2	
5/22/72	2	2	<2	<2	<2	<2	

Source: EPA Laboratory, Region IX

SAN FRANCISCO BAY SHELLFISH STUDY

Bacteriological Tests of Overlying Waters

Shellfish Bed Location and Number: Tara Hills No. 2 (32)

COLIFORM, MPN/100 ML

Date Sampled	STATION A		STATION B		STATION C		Remarks
	Total, Confirmed	Fecal	Total, Confirmed	Fecal	Total, Confirmed	Fecal	
4/10/72	2	<2	5	5	2	<2	
4/14/72	<2	<2	2	<2	14	14	
4/16/72	8	5	13	8	14	5	
5/8/72	70	<2	5	<2	<2	<2	
5/9/72	5	<2	<2	<2	2	<2	
5/11/72	<2	<2	<2	<2	<2	<2	
5/12/72	8	2	<2	<2	<2	<2	
5/17/72	2	<2	23	2	<2	<2	
5/18/72	<2	<2	<2	<2	<2	<2	
5/22/72	<2	<2	2	2	4	2	

Source: EPA Laboratory, Region IX

SAN FRANCISCO BAY SHELLFISH STUDY

Bacteriological Tests of Overlying Waters

Shellfish Bed Location and Number: Tara Hills No. 3 (33)

COLIFORM, MPN/100 ML

Date Sampled	STATION A		STATION B		STATION C		Remark
	Total, Confirmed	Fecal	Total, Confirmed	Fecal	Total, Confirmed	Fecal	
4/10/72	2	<2	2	<2	<2	<2	
4/14/72	7	2	4	2	2	2	
4/16/72	<2	<2	<2	<2	2	<2	
5/8/72	<2	<2	<2	<2	<2	<2	
5/9/72	<2	<2	<2	<2	<2	<2	
5/11/72	2	<2	<2	<2	<2	<2	
5/12/72	2	<2	<2	<2	2	<2	
5/17/72	5	<2	2	<2	2	2	
5/18/72	170	13	490	8	11	<2	
5/22/72	5	2	2	2	<2	<2	

Source: EPA Laboratory, Region IX

SAN FRANCISCO BAY SHELLFISH STUDY

Bacteriological Tests of Overlying Waters

lfish Bed Location and Number: Strawberry Pt. (41)

COLIFORM, MPN/100 ML

pled	STATION A Total, Confirmed	STATION A Fecal	STATION B Total, Confirmed	STATION B Fecal	STATION C Total, Confirmed	STATION C Fecal	Remarks
0/72	5	2	7	7	8	5	
1/72	180	49	230	79	330	79	
2/72	170	170	130	49	130	27	
3/72	130	49	79	79	170	23	
4/72	17	2	7	7	49	13	
/72	33	7	17	2	49	11	
/72	13	<2	540	230	540	170	
1/72	230	8	180	33	49	23	
2/72	46	23	46	46	79	27	
5/72	< 2	<2	7	7	180	180	Station A Sampled on 5/17/72

rce: EPA Laboratory, Region IX

SAN FRANCISCO BAY SHELLFISH STUDY

Bacteriological Tests of Overlying Waters

Shellfish Bed Location and Number: Richardson Bay (42)

COLIFORM, MPN/100 ML

Date Sampled	STATION A		STATION B		STATION C		Remarks
	Total, Confirmed	Fecal	Total, Confirmed	Fecal	Total, Confirmed	Fecal	
4/10/72	110	17	3500	40	1400		
4/11/72	1300	330	1300	94	230	130	
4/12/72	2300	330	130	130	490	110	
4/13/72	700	94	180	140	170	79	
4/14/72	49	22	23	23	8	5	
5/8/72	22	5	130	33	130	22	
5/9/72	790	170	790	490	790	26	
5/11/72	170	22	33	23	49	33	
5/12/72	220	140	110	22	49	8	
5/15/72	79	79	920	350	170	79	

Source: EPA Laboratory, Region IX

SAN FRANCISCO BAY SHELLFISH STUDY

Bacteriological Tests of Overlying Waters

Shellfish Bed Location and Number: Johnson Oyster Co., Drakes Estero - CONTROL

COLIFORM, MPN/100 ML

Date Sampled	STATION A		STATION B		STATION C		Remarks
	Total, Confirmed	Fecal	Total, Confirmed	Fecal	Total, Confirmed	Fecal	
5/23/72	5	5	<2	<2	<2	<2	

Source: EPA Laboratory, Region IX

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